



Nanotube Superfiber Materials: Chapter 24. Embedded Carbon Nanotube Sensor Thread for Structural Health Monitoring and Strain Sensing of Composite Materials (Micro and Nano Technologies)

Adam Hehr, Yi Song, Bolaji Suberu, Joe Sullivan, Vesselin Shanov, Mark Schulz

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This chapter investigates the use of carbon nanotube (CNT) sensor thread in distributed structural health monitoring (SHM) systems, specifically as embedded damage and strain sensors. The CNT sensor thread has shown potential to be integrated into/onto composite materials to provide confident damage detection, localization, and characterization in complex geometries without complicated detection algorithms and minimal sensing channels. This chapter articulates current work done with CNT thread in Nanoworld Laboratories, specifically CNT thread performance as a sensor; past, current, and future embedded sensing work; and potential SHM design architectures for aircraft, along with a description of a few potential multifunctional aspects of the material. Multifunctional here implies improving the composite material besides self-sensing of damage and strain. Some of these multifunctional characteristics include self-sensing of moisture, oxidation, and temperature; improved mechanical properties of damping, toughness, stiffness, and strength; and improved thermal and electrical transport, among many other potential areas. Besides these multifunctional characteristics, CNT thread is low in weight and small in size and the material is modest in cost. As a consequence of these strong sensor and material characteristics, the authors believe that this could be a game-changing material for high-cost composite commercial and defense vehicles. Future military and commercial composite vehicles will have “nano inside” to provide safety, reliability, durability, condition-based maintenance, and multifunctionality.

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